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ABSTRACT

This study examined the adaptability of reading rate to passage difficulty under different conditions of task-induced processing. Sixteen experimental passages varying in subject matter and ranging from 85 to 171 words were selected from a set of 32 texts rated for comprehensibility. The eight easiest and eight hardest texts were selected. Another eight texts were selected for use as practice passages. Two word lists were generated for each of the 24 texts. The type of word match determined whether the reader need only attend to the physical features of the words (Search Condition) or whether the reader had to make semantic interpretations of the words (Memory Condition). The subjects were paid high-school volunteers. Thirty-four served in the Search Condition and 34 in the Memory Condition. Subjects in the Search Condition saw the list of words they had to match with text words before reading a passage. Subjects in the Memory Condition did not see the list of words before reading a passage. The results indicated that readability would have little effect on rate in the Search Condition when subjects matched words on the basis of physical identity. Matching for synonymity in the Search Condition caused subjects to read the passages more slowly. (WR)

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READING RATE, READABILITY AND VARIATIONS IN TASK-INDUCED PROCESSING

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Recent research reported by Carver, by Miller and Coleman, by Sticht and by myself strongly suggests that the readability level of prose has little effect on reading rate, when rate is measured in units smaller than a word. These observations have lead Miller and Coleman, among others, to conclude that readers do not readily adapt their reading rate to the difficulty of a passage.

Whether or not this conclusion is true deserves further investigation. Reading rate is generally believed to be a good behavioral index of readability. Support for this belief can be found in a number of studies in which the unit for measuring rate has not been a factor. For example, word recognition time varies with familiarity even when word length is taken into account. Also, sentence processing time varies with syntactic complexity independently of sentence length.

Why then did the studies cited above find so little relationship between the readability of a passage and reading rate? One reason may be that the reading tasks used in these studies were not appropriate for showing such a relationship.

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The hypothesis is suggested here that reading rate only becomes contingent on a text's readability when readability influences the cognitive processing involved in performing the experimental task.

The present study examined the adaptability of reading rate to passage difficulty under different conditions of task-induced processing. A word matching task was used to produce the inferred cognitive processing. Calfee and Jameson have already demonstrated that differences in task-induced processing can affect reading rate.

As shown in Table 1 of the handout, the reading task was structured so that the reader either had to match words while reading a text or had to remember the passage for a subsequent word match. The type of word match determined whether the reader need attend only to the physical features of the words while reading or whether the reader had to make semantic interpretations of the words as he read. The techniques for achieving these conditions will be described later.

The expected effects of readability on task-induced processing are shown in the 3rd column of Table 1. These expectations about the effect of readability on processing lead to the predictions in column 4 about the influence of readability on reading rate.

In the Search Condition, the reader should be able to adequately match words for physical identity by attending to each text word seperately. The semantic and syntactic context of words can be ignored in this task. Therefore,

readability was expected to have no effect on reading rate.

When readers search for synonyms, on the other hand, word context becomes an important factor. This need to make semantic interpretations of words in the Search Condition was expected to slow down reading rate in general. In addition, readability was expected to have some influence on rate, since obviously word comprehension is related to readability. However, the Search Condition readers who match for synonymity should confine their attention to within-sentence constraints, thus limiting the effect of passage difficulty on rate.

Readability was expected to have its greatest effect in the Memory Condition. To perform this task, readers were expected to remember the gist of the passages since passage length ruled out rote memorization as an effective strategy. Text difficulty is known to influence the ease with which passage meaning can be remembered; therefore, harder texts should be read more slowly in the Memory Condition. The reader's knowledge about the general type of word match he would make after reading a passage was expected to have little influence on reading rate in the Memory Condition. Readers were expected to try to remember the overall meaning of a passage regardless of the type of word match.

The matching task used in this study required that readers indicate the words in a word list that did not match words in the text. The non-matching words were identified after

a text was read in both the Search and Memory Conditions. This technique of identifying non-matching words allowed text reading times to be recorded in the Search Condition. The entire passage had to be read before a reader could determine that a list word did not match a text word. This non-matching task is a potentially valuable technique for reading research since it is one way of ensuring that a passage has been read at least once.

METHOD

The experimental procedures used in this study are outlined on pages 2 to 5 of the handout. 16 experimental passages varying in subject matter and ranging from 85 to 171 words were used in this study. These passages were chosen from a set of 32 texts rated for conprehensibility in a previous study. The 8 easiest and 8 hardest texts were selected. Comprehensibility ratings were used in selecting the material to avoid the familiar problem of choosing incomprehensible passages classed as easy by a readability index and visa versa. Another 8 texts were selected for use as practice passages. These texts were of average difficulty.

Two word lists were generated for each of the 24 texts. The lists determined the type of word match to be made. An example of the two types of lists are shown in Table 3. Each list was 3 words long and contained either 1 or 2 words that matched text words. A list with 2 matching words is shown

in the example. For the ID-list, each matching word corresponded to exactly one word in the text. Each matching word in the SY-list was a synonym of an ID-list word. Thus, each matching word in the SY-list was a synonym of exactly one word in the text. The non-matching word or words in a list had no semantic relationship to words in the text. As shown in Table 3, the ID and SY lists for a text contained the same non-matching word(s). The words in the list were chosen in an unsystematic way. The lists words were reasonably familiar and represented all parts of speech.

All 16 experimental and 8 practice texts were read by each subject. Half the texts read by a single subject were paired with their ID-lists and half with their SY-lists. The kind of list paired with a text determined the type of word match the subject made after reading the text.

Each subject was assigned either to the Search Condition or to the Memory Condition. As shown in Table 4, subjects in the Search Condition saw the list of words they had to match with text words before reading a passage. Subjects in the Memory Condition did not see the list of words before reading a passage. Subjects in both conditions checked non-matching words after reading a text.

Table 5 outlines the sequence in which material was presented to subjects in both the Search and Memory Conditions.

As Table 5 shows, all texts paired with one type of word list were shown in sequence followed by all the texts paired with the other type of word list. Matches were recorded immediately after each text was read. Subjects were told about the type of word match they had to make before beginning each block of texts. Therefore, subjects in both the Search and Memory Conditions knew the general type of word match they would have to make. Search Condition subjects knew, in addition, exactly which words were to be matched for each text.

As can be seen in Table 5, 4 easy and 4 hard texts were assigned to each type of word match made by a subject. Over all subjects in each condition each text occurred approximately equally often under each type of word match and in the 1st and 2nd block of the reading sequence.

Reading times were recorded by the subject who wrote his start and finish time on each text page. Times were recorded to the nearest 5 seconds.

The subjects were paid high-school volunteers. 34 served in the Search Condition and 34 in the Memory Condition.

RESULTS

The results for reading rate are shown in the figure on the left side of page 6. The length of each text was expressed in terms of the number of letter spaces, including blanks and punctuation marks, and this measure of physical extent was used to convert reading times to rates

in letter-spaces-per-minute. In analyzing these results, a logarithmic transformation of the data was used since the variance of time measures tends to be correlated with the mean.

An analysis of variance was run on the data with reading condition as the between-subjects variable and readability and type-of-match as the within-subjects variables. The main effects of readability and type-of-match were significant ($F = 77.24$ and 42.98, $df = 1/198$, $p < .05$) as were the interactions between reading condition and readability and reading condition and type-of-match ($F = 20.68$ and 50.92, $df = 1/198$, $p < .05$). The main effect of reading condition and all other interactions were not significant. The specific predictions about the effects of readability on reading rate outlined in Table 1 were evaluated by a Student-Newman-Keul's test on the treatment means.

As you can see from the figure, the results support the prediction that readability would have little effect on rate in the Search Condition when subjects matched words on the basis of physical identity. As expected, matching for synonymity in the Search Condition caused subjects to read all passages more slowly. However, the prediction was not confirmed that synonym search would be faster for easy texts than for hard texts. The results suggest that readability made no difference in reading rate when readers were looking for synonyms.

The figure on page 6 shows that readability had its greatest effect in the Memory Condition. As predicted, hard texts were read much more slowly than easy texts. It was also predicted that in the Memory Condition, a reader's general knowledge about they type of word match he must make after reading a text would have no effect on his reading rate. The results support this prediction.

Table 6 on the right side of page 6 shows how well readers performed the matching task. The total number of list words correctly classified as matching or not matching words in the texts was tabulated for each subject for each type of word match. The mean percentage of correctly classified words was then calculated for each condition, as shown in Table 6. Chi-Square tests indicated that for all conditions, the number of correctly classified words exceeded the chance expectation of 50% correct. These results show that readers were able to perform the matching tasks reasonably well, although there are certainly interesting differences between conditions.

DISCUSSION

The results of this study show that reading rate is sensitive to the amount and/or type of cognitive processing required by a reading task. These results support the hypothesis stated earlier that readers will readily adapt their reading rate to text difficulty if readability affects the task-induced processing.

The predictions made in Table 1 were generally supported by the results. Exactly why the reading rate for hard texts was not slower than that for easy texts in the Search Condition when readers matched words for synonymity is not clear from this study. One possibility is that readers found the task too difficult in this condition. As Table 6 indicates, subjects in the SY-list Search Condition were not as accurate in matching words after reading hard texts. However, examination of the reading rates of subjects who performed poorly and subjects who performed well on the hard texts showed no relationship between reading rate and performance of the matching task.

To conclude, this study clearly demonstrates the dependence of reading rate on the reading task. One important consequence of this finding for reading research is that reading rate, per se, cannot be used as a behavioral index of readability. However, reading rate's sensitivity to the processing induced by the reading task makes it a useful measure for exploring the effects of readability on cognitive processing.

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Table 1: Structure of the reading task used to produce inferred differences in cognitive processing and the expected effect of readability on reading rate.

READING CONDITION	TYPE OF WORD MATCH	EXPECTED EFFECT OF READABILITY ON PROCESSING	PREDICTED EFFECT OF READABILITY ON RATE
Words matched while reading (Search Condition)	physical identity of words (ID-list)	No effect of readability (Matching can be done without comprehension of meaning.)	NO EFFECT
	synonymity of words (SY-list)	Some effect of readability (Semantic interpretation of words required for word matching.)	Hard texts read more slowly than easy texts
Words matched after reading (Memory Condition	physical identity of words (ID-list)	Large effect of readability (Text content had to be remembered. Text length precluded rote memory of all words as an effective strategy for performing the matching task.)	Hard texts read much more slowly than easy texts
	synonymity of words (SY-list)		

Table 2: The comprehensibility ratings and Flesch Reading Ease Scores for the easy and hard texts.

	EASY TEXTS	HARD TEXTS
Number of texts - - -	8	8
Comprehensibility rating: (1=very hard 5=very easy)		
MEAN - - - - -	4.4	1.9
RANGE- - - - -	4.02-4.85	1.52-2.38
Flesch Reading Ease Score:		
MEAN - - - - -	32	80

Table 3: Example of the ID-list and SY-list associated with a single text.

RELATIONSHIP BETWEEN A LIST WORD AND A SINGLE TEXT WORD	ID-LIST	SY-LIST
match	annual	yearly
match	areas	regions
non-match	nobility	nobility

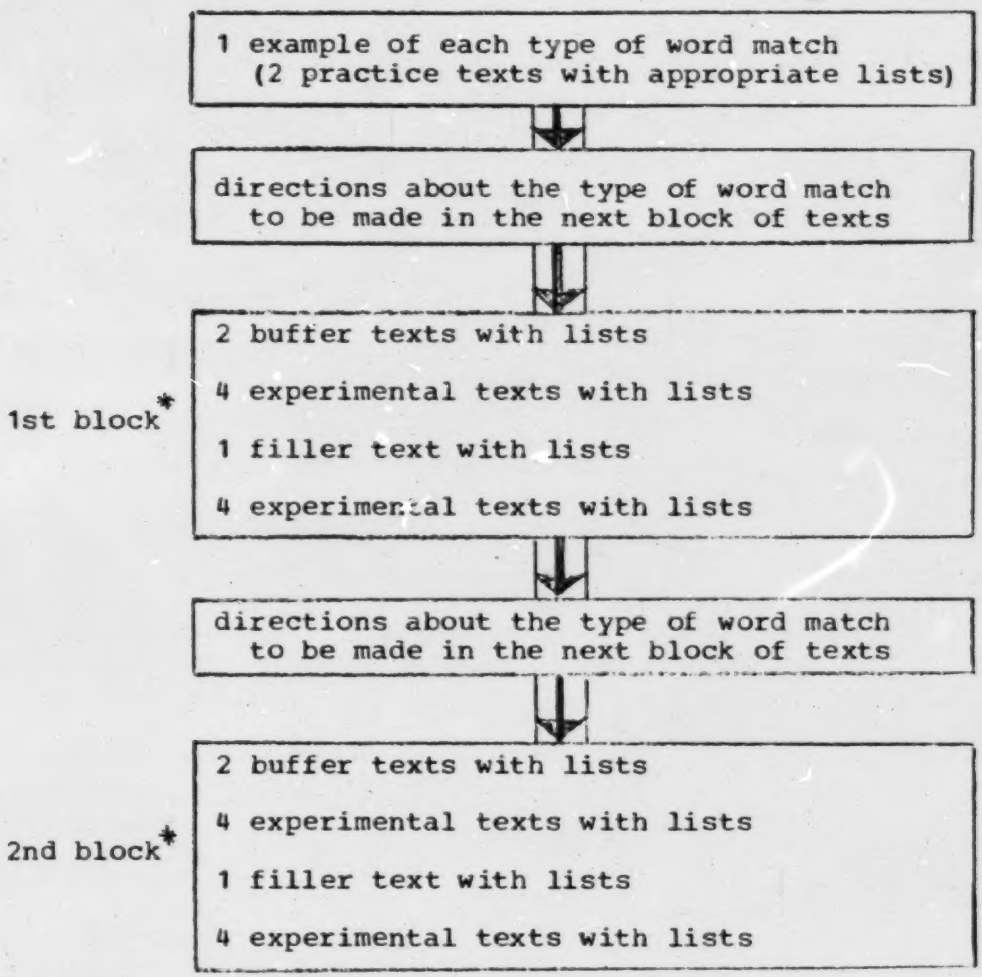
Table 4: The order of presentation of the list and text material for a single text for each of the two reading conditions.

PAGE SEQUENCE*	SEARCH CONDITION	MEMORY CONDITION
1st	list of 3 words to be matched against text words during reading	TEXT
2nd	TEXT	list of 3 words (S must check the non-matching words.)
3rd	same list of 3 words (S must check the non-matching words.)	

* S could look at each page as long as he wished, but he was instructed never to turn back to a page.

Table 5: The sequential organization of all text materials for each subject. Each text and each list was printed on a separate page.

READING SEQUENCE


1 example of each type of word match
(2 practice texts with appropriate lists)
directions about the type of word match to be made in the next block of texts
1st block*
2 buffer texts with lists
4 experimental texts with lists
1 filler text with lists
4 experimental texts with lists
directions about the type of word match to be made in the next block of texts
2nd block*
2 buffer texts with lists
4 experimental texts with lists
1 filler text with lists
4 experimental texts with lists

* Over the 8 experimental texts in a block, 4 texts were hard and 4 texts were easy.

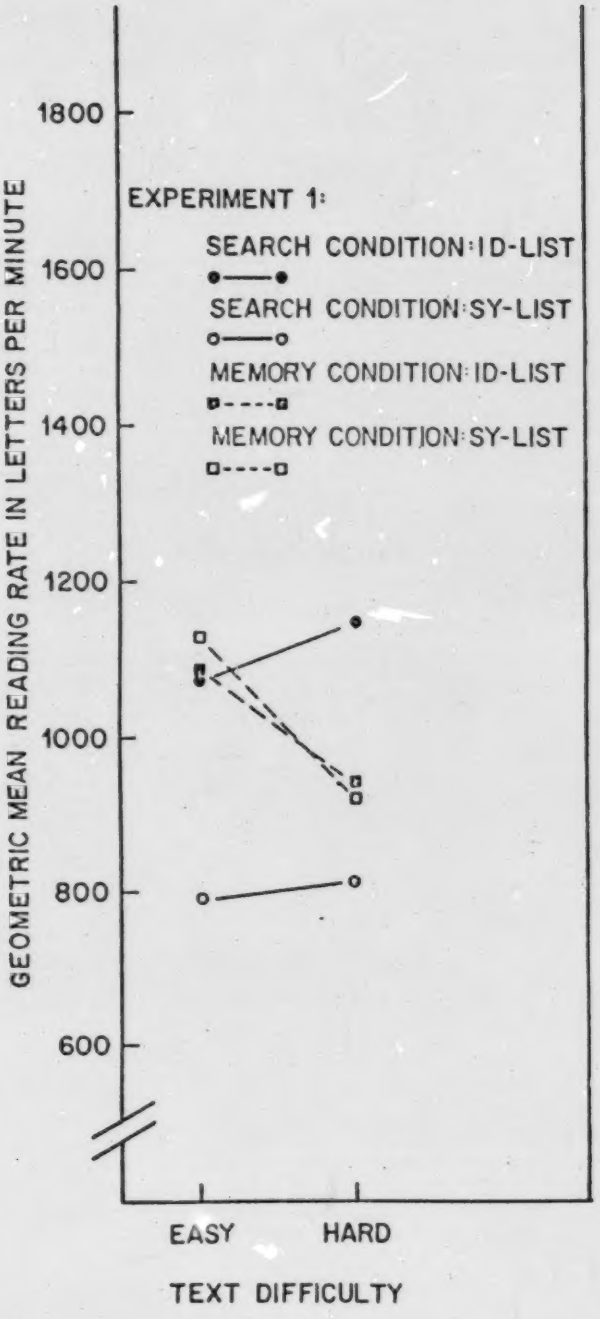


Table 6: The percentage of correctly classified words as a function of reading condition and type of word match for hard and easy texts.

	EASY TEXTS	HARD TEXTS
SEARCH CONDITION		
ID-list	86%	87%
SY-list	78%	65%
MEMORY CONDITION		
ID-list	84%	64%
SY-list	74%	62%